Reports from astronomical centres

Indian Institute of Astrophysics

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Solar physics

A major event of the year was the total solar eclipse of 1980 February 16. Two camps were set up, one at Hosur, about 40 km south of Hubli and the other at Jawalgera, about 50 km east of Raichur. The camp at Hosur housed the long-focus camera for the photography of the corona, the polarigraph and the coronal spectrograph. The high dispersion multislit coronal spectrograph, the tower spectrograph for rapid sequence photography of the neutral potassium line close to the solar limb, a Paschen-Runge monochromator for limb darkening measures and a telescope with the 0.5 Å H-alpha filter were set up at the Jawalgera camp.

Coronal spectra in the light of the Fe X (6374 Å) line were obtained by Saxena and Jagdev Singh with a multislit high dispersion spectrograph and image tube arrangement. Two spaced exposures provide a range of locations for evaluating the half-widths of the lines for the determination of kinetic temperature while the neon spectrum through an adjacent window provided the reference for evaluting the line-of-sight velocities. The coronal spectra of the east and the west limbs at a dispersion of 28 Å mm^{-1} range 3400 Å to 7500 Å were obtained by Rajamohan and Raheem with a twin Ebert-Fastie-type spectrograph. Some fine spectra were obtained on III-F emulsion showing the H-alpha line in emission in addition to the strong lines Fe XIV (5303 Å), Fe X (6374 Å), Ni XV (6702 Å). That the H-alpha emission line can be seen in coronal spectra gains further support from photographs of the corona obtained by Rangarajan and Giridhar through a Halle H-alpha filter of 0.5 Å passband attached to a 10-cm, f/10 telescope.

The limb darkening at the extreme limb and the chromospheric continuum at 3600 Å in the Balmer continuum and at 4800 Å were photoelectrically recorded by Bhattacharyya. Apart from providing the darkening parameters at the very outer limb, the ratio of intensities in the chromospheric region permit evaluation of densities. Eleven exposures on the corona were obtained during totality by Jayachandran and Babu with a quadruple polarigraph. The four simultaneous pictures were obtained at $\lambda_{eff} = 6300$ Å with each polaroid oriented 45° to its neighbour Scaria and Bagare obtained 5 exposures of the corona. These high resolution photographs show wealth of fine detail including the changing forms of a coronal transient.

At the solar tower telescope at Kodaikanal K-line spectra in integrated sunlight continue to be obtained on a regular basis. As a part of the program for the Solar Maximum year (SMY), rapid sequence of K_{232} spectroheligrams (at 1/2 min intervals) at an image scale 33 arcsec mm^{-1} were obtained for selected active regions as recommended by the Scientific Committee on Solar Terrestrial Physics (SCOSTEP) under the Flare Build-up Study (FBS) and Study of Energy Release in Flares (SERF) program. The magnetic fields of sunspots were recorded photographically on 102 days by Jayachandran, Bagare and Gupta with the aid of the Zeeman-sensitive Fe I line 6303 Å. In addition, they have secured several high resolution spectroheliograms, of active regions and their neighbourhood, with a beam splitter and polaroid, with the aim of constructing a magnetogram.

First trials with the new solar tower and the low dispersion echelle spectrograph for the study of line profiles of the neutral potassium resonance line at 7699 Å near the limb of the sun were made at the recent solar eclipse. Further work on this program will continue at Kavalur where rapid sequence spectra will be obtained.

Sivaraman's proposal for a project entitled 'Very high resolution measurement of photospheric magnetic fields in the interior of the supergranular network on the solar surface' to be carried out at the solar telescope of the Kitt Peak National Observatory, Arizona, has been accepted as a collaborative program and observing time allotted. The aim is to find out directly the nature of the relation between the sub-arc second magnetic features and the bright points seen in the spectroheliograms of the K-line of Ca^+.

Gokhale has shown that for several varieties of solar magnetic and emission features the nature of their differential rotation and its variation with the solar cycle can be predicted from the topology of the two families of flux tubes in the 'shock-transition model' of the solar magnetic cycle proposed by him earlier. He also finds that the 'two-component model of the solar activity cycle' which follows as a corollary of the 'shock-transition model' provides a correlation between the long lived coronal hole formations during the ending years of a solar cycle and the maximum annual sunspot number R_{max} of the succeeding cycle. This might account for the observed correlation between the geomagnetic activity indices during the last few years of a solar cycle and the R_{max} of the next cycle.

Gokhale and Sivaraman have continued the computation of the yearly sums of the maximum areas reached by individual sunspot groups, using the Greenwich photoheliographic data. These sums are expected to serve as an improved measure of the magnetic flux emerging above the sun's surface. From the frequency distribution of the sunspot groups with respect to the maximum areas they attain, Gokhale and Sivaraman find that at least in each of the three solar cycles from 1889 to 1923, the magnetic flux tubes emerging above the Sun's surface *did* come from *two* families of flux tubes with distinct thickness distributions.

Gokhale and Hasan have developed a qualitative magnetohydrodynamical model of the quiescent prominence in which a magnetic reconnection in the corona leads to an upwelling of plasma and magnetic flux from the photosphere. Raju in collaboration with B. N. Dwivedi of Banaras Hindu University has investigated in detail the electron density dependence of solar emission lines from boron-like ions using the most recent atomic data. They find that the ratios of several emission lines of Mg VIII and Si X ions are density sensitive, some of which can be used as

density indicators for the chromosphere-corona transition region and the corona. They are now working out how the various emission line intensities would be affected when one moves from a quiet region to a nearby coronal hole.

Hasan and Venkatakrishnan have continued their study of the flow of gas in a magnetic flux sheath in hydrostatic equilibrium which collapses normal to itself. They follow the time dependent flow of the gas along the field lines induced by this collapse, using the non-linear MHD equations. They have developed a computer code to model the flow for a variety of sheath geometries and for different velocities of normal flow. These considerations have been applied by them to obtain a model for the flow of gas in a spicule. They find that a starting velocity of collapse of about Mach 4 will induce a vertical velocity of Mach 2 (about 20 km s^{-1}). Once the collapse starts, a much lower normal velocity ($\approx$ Mach 1) is sufficient to sustain the spicule flow. Preliminary calculations suggest that the trigger for collapse may be provided by the thermal instability.

Using the Gauribidanur low-frequency array, which is a joint project with Raman Research Institute, Bangalore, Sastry and his collaborators have observed the slowly varying component of the radio emission from the sun at a frequency of 34.5 MHz. They find that the peak brightness temperature varies between 0.3×10^6 K and 1.5×10^6 K. The half power width of the brightness distribution is about 3 solar radii. The emission is interpreted as the thermal emission from regions where the electron density is five to ten times that of the normal corona and the temperature is of the order of a million degrees.

Krishan, Sastry and Subramanian have used a collisionless decay mechanism for the electron plasma waves in an electron-beam plasma system in order to explain the observed decay constant and its relationship with the exciter duration in the case of type III solar radio bursts. This correlation is absent however for those type III bursts that are preceded by type IIIb radio bursts. Krishan has examined the possibility of direct generation of electromagnetic radiation at and near the electron plasma frequency from an electron beam magnetoplasma system. The role of the electron beam is replaced by the electron plasma electrostatic wave generated by it. Under the combined influence of this electrostatic field and the magnetic field, the collective motion of the plasma particles gives rise to electromagnetic modes at frequencies close to the plasma frequency. The frequency spectrum has a split structure, the splitting depending on the electrostatic field produced by the electron beam. The results are used to explain the type IIIb solar radio bursts.

Physics of the stars

Lunar occultations of 24 stars have been observed photoelectrically by Bhattacharyya, with the 102-cm Kavalur reflector. Bhattacharyya, in collaboration with D. P. Sharma of the Indian Space Research Organisation, Bangalore, has made photoelectric observations of the two x-ray sources, Sco X1 and X Per. He and Shylaja have observed eight cataclysmic variables in the course of 24 nights using the fast photoelectric recording system.

Kameswara Rao, in collaboration with D. P. Gilra and P. R. Wesselius of Kapteyn Astronomical Institute, Groningen, has completed a preliminary analysis of late type stars with hot companions by combining his own observations with the 102-cm

Kavalur reflector with those from the International Ultraviolet Explorer (IUE) for o Cet, ϵ Aur, π Pup and HD 62001. The IUE observations confirm that the companion of ϵ Aur is an A3 Ib star and that π Pup is a K4 III star with a companion of spectral class B2-B3. The ultraviolet spectrum indicates that the hot companion is surrounded by a gaseous ring or a disk. They have noticed that the nebula VV 1-7 surrounding HD 62001, seen on the blue plates of the Palomar sky survey (epoch 1953) is absent both on the ESO sky survey plates (epoch 1976) and on those obtained in 1980 with the 102-cm Kavalur reflector. From further photometric and spectroscopic observations of HD 62001 they conclude that the star may be a binary. They have derived values of $T_{eff} = 9200 \mp 200$°K and log $g = 3.8 \pm 0.2$ with no significant infrared or ultraviolet excess. Low resolution IUE spectra show P Cygni profiles for 1332 Å C II and for the 2800 Å Mg II doublet.

Kameswara Rao has completed a study of five R CrB type stars. Combining the infrared observations of UV Cas obtained at the Kitt Peak National Observatory by B. J. McNamara and the spectroscopic observations of Nesci Zavatti, he had detected an infrared excess at the maximum light phase, common characteristic of R CrB stars. On the other hand XX Cam has an energy distribution of a 7000 K black body with no infrared excess unlike a typical R CrB star. From spectrograms he also finds that XX Cam is more deficient in hydrogen than RY Sgr and R CrB, while it is more abundant in carbon. He has also obtained new infrared observations of DZ And, BD — 13°3407 and R CrB in collaboration with P. V. Kulkarni and N. M. Ashok of the Physical Research Laboratory, Ahmedabad. A continous monitoring of R CrB with K filter (2.2μ) revealed variations on a time scale of 10 to 20 min. From *UBV* observations and spectrograms, Kameswara Rao finds that GU Sgr, a typical R CrB star, shows light variations of 0.3 mag in V with a period of 30 days; DZ And shows H-alpha in absorption which excludes it from the membership of the R CrB class. He has derived the circumstellar reddening relation

$$\Delta V/\Delta(B-V) = 4.3 \text{ and } \Delta(U-B)/\Delta(B-V) = 1.47 \text{ for SU Tau}$$

at the time of its emergence from the minimum. From *UBV* observations of BD —18°1946 (HR 2947), Kameswara Rao suspects the star to be a light variable.

Rajamohan and Venkatakrishnan have completed their study of rotation in binaries. They conclude that the tidal effects during the main sequence phase of binary components cannot explain the observed rotational behaviour of the main sequence components in detached systems. In analogy with single stars there exist two groups of normal and peculiar systems among the binary stars. They attribute the difference in behaviour of the two groups to the magnetic braking during the pre-main sequence stage. According to them the rotational behaviour of primaries of semi-detached systems is no different from that of stars in detached systems. They interpret the absence of rotational anomalies in primaries of Algol types as either due to the entire mass and angular momentum being lost from the system or due to the additional angular momentum acquired by the primary being transferred back to the orbit on short time scales. This may seem to contradict the phenomenon of mass transfer which is invoked to explain the very existence of these systems. But their hypothesis that the origin and the evolutionary time scales of detached and semi-detached systems are different may explain this satisfactorily.

Parthasarthy and Kameswara Rao have completed their study of lithium abundance in weak G-band stars and find that it is linearly correlated with CH deficiency. Lithium production is probably caused by spallation reactions on the surface of a star after it has left the main sequence. Mixing due to meridional circulation on the giant branch might bring out CN processed material to the surface and at the same time destroy the surface lithium. Thus both carbon and lithium get depleted together Determination of isotope abundance ratios $^{12}C/^{13}C$ and $^{6}Li/^{7}Li$ and C, N, and O abundances for a significant sample of weak G-band stars would be extremely useful.

Rajamohan has commenced a program of studying the short-term light variations in the Ca II H and K emissions, in the range 1–30 min, of late type stars. Observations of HR 4665 and o Dra, centered on the K line (25 Å bandpass), indicate no variations in the above period range.

Raveendran, Mekkadan and Mohin have completed the analysis of the *UBV* photometric data of the eclipsing binary system ζ Aur obtained by them with the 34-cm Kavalur reflector during the 1977 and 1979 eclipses. They obtain a mean depth of 1.831 mag in *U*, 0.529 mag in *B* and 0.163 mag in *V* from the 1977 observations, while the respective values from the 1979 observations are 1.952 mag, 0.509 mag and 0.134 mag. Combining their results with those in the literature they conclude that the long term intrinsic variations in the brightness ascribed to the late type supergiant are negligible, if at all there.

Mekkadan, Raveendran and Mohin have monitored photometrically HD 166181, which is a single-line spectroscopic binary with strong and narrow H and K emission. They find that the system shows a pattern of behaviour similar to that of the RS CVn group of binaries. They have done the *B*, *V* photometry of HD 224085, another single-lined spectroscopic binary with strong Ca and H-alhpa emission. The amplitudes in *B* and *V* are about 0.15 mag. The light curve is asymmetric and indicates a highly non-uniform brightness distribution on the surface of the visible primary. The mean brightness of the system has continued to decrease secularly since 1974. The observed spectrum-line broadening is interpreted in terms of large scale turbulence rathar than rotational broadening.

Scaria and Bappu have completed a detailed photometric study of the cluster ω Cen. Using photoelectric scans made along the major and minor axes in *UBVRI* bands along with the equidensity contours obtained from direct photographs of the cluster with an f/6 camera in *B*, *V* and *I* bands, they have evaluated the change in ellipticity from the centre to the outer regions of the cluster. The observations are interpreted in terms of a concentration of resolved and unresolved blue stars in the annular zone between 2.5 and 5.5 arcmin from the centre, which show a more elliptical distribution as compared to the more abundant and brighter red stars in the cluster. The *UV* colour excess in this zone is about 0.2 mag larger than that for the other parts of the cluster. Using King's theoretical models, they have determined the core radii for the cluster along the major and minor axes in *UBVRI* bands. The cluster looks more flattened at shorter wavelengths. There is also no asymmetrical absorption by interstellar dust over the cluster, even though its galactic latitude is only 15°. Extending this study to other clusters and using similar data available in the literature, they find the presence of a blue bulge in all of them. A close similarity is also seen between the variations in ellipticity over ω Cen and the

rotation in the nuclear bulge of M31. The technique of composite photography is also used to bring out the distribution of blue horizontal branch stars in ω Cen.

Pati has commenced a program to obtain the integrated spectral scans of globular clusters with the automated scanner at the 102-cm Kavalur reflector. He plans to use spectral features, especially in the green and red regions, as discriminating characteristics in population synthesis.

Babu and Bappu have continued to obtain objective grating spectra of galactic clusters in the declination belt $-30°$ to $-50°$. From among the six clusters observed, three have stars of spectral type B5 or earlier and are thus young clusters while the remaining three are definitely of the older type. Stars of different brightness in these clusters have been measured photoelectrically for the purpose of obtaining the distance moduli.

Babu has in progress the analysis of the observations made at the 102-cm Kavalur reflector of 45 Ap and Am stars to obtain their effective temperatures, radii and bolometric magnitudes. Shylaja and Prabhu have obtained photoelectric and photographic spectra of the recurrent nova U Sco during its recent outburst. The spectrum shows the strong lines of H_β and $\lambda\lambda$ 4640 complex, H_β yields a value of electron density, $N_e = 6.6 \times 10^8\ r_{kpc}\ \mathrm{cm}^{-3}$ and the mass of ionized hydrogen in the shell $M_{HII} = 4.4 \times 10^{-7}\ r_{kpc}\ M_\odot$. Here r_{kpc} is the distance to the nova in kiloparsecs and is highly uncertain.

Peraiah has extended his work on partial frequency redistribution to the solution of line transfer in a comoving frame. However, the transformation of the radiation field from comoving frame into that of the observer (say at earth) has encountered some difficulty. In the comoving frame the redistribution function is computed only once, whereas in the transformation this has to be done several times requiring large amounts of computing time. To avoid this he has confined the computations to the angle-averaged functions. He has carried out further tests on the iterative process of obtaining a simultaneous solution of the line transfer in the comoving frame and statistical equilibrium equation for a non-LTE two level atom. Peraiah finds that higher gas velocity gradients would fill the upper levels more efficiently than the low velocity gradients and that constant velocity of the gases is not very efficient in changing the populations of the levels. Large geometrical extensions of the atmosphere reduce the effect of the high velocity gradients. In the case of a highly extended medium, even a large velocity gradient will have only a marginal effect. Peraiah's method gives a direct solution of line transfer and converges faster than the method of Mihales, Hummer & Kunasz which employs an iterative solution of line transfer ; the former requires 3 or 4 iterations while the latter fifteen. Peraiah has in progress a scheme to include the equations of hydrodynamics for the resonance lines and the equation of continuity. In order to minimize the number of iterations he has linearized the equation of continuity and incorporated a local iteration between the equations of hydrodynamics and continuity. This reduces the large number of iterations among the four non-linear equations and thereby saves computing time considerably.

Peraiah has investigated the effect of various parameters like velocities and geometrical extensions in combination with a given radiation field on the radiation pressure in a resonance line. He finds that for a medium with given absorption characteristics, the geometrical extension affects the line pressure most and this holds true in both collision—dominated and photoionization-dominated lines.

He has generalised his calculations of the line profiles emerging from a radially expanding stellar atmosphere by including the effects of rotation and assuming an appropriate radiation field. This seems to have varying effects on different types of lines; for a P Cygni type profile, *e.g.*, emission and absorption get enhanced. The redshifted emission peak is further redshifted and similarly the absorption is further blueshifted causing the line to become broader. Rangarajan and Mohan Rao are applying this scheme to simulate the PV profile of θ^2 Ori.

Kochhar has commenced the study of the progenitors of supernovae (SN) of types I and II. Since both, SN of type II and massive close binaries, are confined to the spiral arms, the SN occurring in close binaries should be of type II. He postulates that, inspite of mass transfer in close binaries, the exploding star should have a hydrogen rich envelope around it, to give rise to a SN II light curve. Such an envelope could be a circumbinary shell. Alternatively, a hydrogen envelope could be transferred back and forth between the two stars if their main sequence masses are roughly equal. He is attempting to explain the bimodal distribution of the mass ratios of binaries in terms of the hypothesis that the binaries with mass ratio $q = M_2/M_1 < 0.5$ tend to evolve to $q \approx 0.3$, while binaries with $q > 0.5$ tend to evolve to $q \approx 1.0$.

Interstellar medium

Shah in collaboration with K. S. Krishna Swamy of the Tata Institute of Fundamental Research, Bombay, has constructed a model of a reflection nebula in the far-infrared. Their geometrical model consists of a homogenous plane parallel slab 1 pc thick with the illuminating star located at 0.35 pc from the front surface of the nebula, and a size distribution function of smooth spherical grains. Using the radiation balance equation for each grain, they have calculated the grain temperature as a function of grain size, off-set angle and position of each grain within the nebula. They find that at a radial distance of about 0.007 pc from the star as the grain radius varies from 0.03 μm to 0.3 μm, the grain temperature spans the range 150 K to 88 K for graphite grains, 91 K to 59 K for icy grains and 81 K to 58 K for silicate grains. Thus the smaller the radius of the grain the higher the grain temperature, other things being equal. These results conform to the general trend that the submicron metallic particles are always hotter than the dielectric particles of the same size in the same radiation field. Shah has used his results on grain temperatures to calculate the expected infrared fluxes in the wavelength range 1 to 100μm with the offset angle as a parameter. The various materials like ice, graphite and silicate show some interesting distinguishable structures in the flux *vs* wavelength curves. A rough estimate for the highest flux turns out to be $F = (5 \times 10^{-12 \pm 1})$ n_H w m^{-2} μm^{-1} sr^{-1} corresponding to offset angle $\phi = 0°$, n_H being the hydrogen number density. The proportionality to n_H is a consequence of a constant ratio of the grain number density to n_H assumed in the calculations. Shah predicts that the best results on the strongest infrared radiation from the Merope reflection nebula can occur near about 40 μ.

Galaxies

Mallik has continued his work on the chemical evolution of our Galaxy. He has evaluated the chemical evolution coefficients using the recent data on stellar evolution

and nucleosynthesis and taking into account the role of the low and the intermediate mass stars in galactic nucleosynthesis. These stars are found to contribute a significant amount of ^{4}He, ^{12}C and neutron-rich species. Comparison with observed abundances suggests a primary origin of ^{14}N. He has used his simple model of galactic evolution with new coefficients to derive the ratio of helium to heavy element enrichment in the Galaxy. The new stellar evolution data cannot explain the observationally determined large value of this ratio. He is currently working on a scheme of chemical evolution allowing for mass loss and incorporating the initial mass function recently determined by Lequeux which is much steeper than the one currently in use.

Prabhu has continued his investigations of the central regions of Sersic-Pastoriza galaxies. A red 'starlike' nucleus is present in several galaxies in the sample. An extreme example is NGC 2903 where the nucleus is not at all visible on the photographs in the blue and the visual regions, but appears prominently on the new near-infrared photographs obtained at Kavalur. The identification of the nucleus is supported by the geometrical and the dynamical evidence. Past investigators of the nucleus of NGC 2903 have all erroneously assumed the brightest and bluest hot spot as the nucleus. A comparison of the geometrical shape of the perinuclear component with the axial ratio of the disk of the galaxy shows a lack of correlation between the two which implies that either the perinuclear component is a prolate spheroid rotating end-over-end or its axis of symmetry is inclined to the rotation axis of the parent galaxy. The major axis of the component has an average value of 3 kpc with the majority of the components having a diameter between 2.5 and 5 kpc. The central brightness of the perinuclear component shows a positive correlation with the linear size of the bar. This observation lends support to the idea that the gas in the central regions of Sersic-Pastoriza galaxies is accreted from the disk owing to the loss of angular momentum at the extremities of the bar.

High energy astrophysics

Das and J. V. Narlikar of the Tata Institute of Fundamental Research, Bombay, have extended their earlier work on the anomalous redshifts of quasistellar objects. They use the conformal gravitation theory of Hoyle and Narlikar to model ejection of a QSO from the nucleus of parent galaxy. The mass of the QSO is zero initially and grows with time. They have constructed a new model by incorporating in the dynamical equations first order cosmological terms which represent the effects of cosmological expansion. They find that the refinement brings about better agreement with the observations of 3C 232 and NGC 3067. According to their model the QSO ejected from the nucleus of the parent companion galaxy with the speed of light has its subsequent motion characterized by the 'firing energy'. For a low enough firing energy the QSO rapidly slows down to non-relativistic speeds, forms a bound system with the galaxy and finally performs radial oscillations (or goes into highly eccentric orbits) of decreasing amplitudes and periods. For firing energy exceeding a critical value the QSO escapes from the neighbourhood of the galaxy. Das & Narlikar have now put forward the hypothesis that all QSOs were born in galactic explosions. The trapped or bound QSOs show up as members of QSO-galaxy pairs whereas the escaped QSOs show no apparent

associations with galaxies. The recently obtained data on anomalous redshifts show redshift bunching and alignments of QSOs of similar redshifts which pair across the galaxy. Das and Narlikar point out that these phenomena are to be expected on the basis of their model. They have done some preliminary statistical analysis of the observational data which show that the observed angular separation *vs* redshift plots can also be adequately explained by their models.

Kapoor had earlier studied the problem of the motion of a test particle in the background of a white hole and of its visibility while still inside the Schwarzchild barrier. He has now extended this to the case of grey holes for which the surface reaches the barrier but cannot burst through. He finds that a particle ejected from the surface of a grey hole and the photons radiated by the particle can leak through the Schwarzchild barrier only before the completion of the expansion of the grey hole. The frequency blue shifts in radiation are not as severe as they are in the case of a white hole. If the expansion is complete, then neither the particle nor the photons it emits can leak through the barrier.

Krishan and N. Gopalaswamy of the Indian Institute of Science, Bangalore, have investigated the absorption of two intense electromagnetic beams in a magnetized plasma. They find that the absorption increases when the frequency of one electromagnetic beam is higher, and that of the other less, than the electron cyclotron frequency. Such a multiphoton inverse-bremsstrahlung absorption mechanism may be responsible in extragalactic radio sources for accelerating electrons to relativistic energies which then emit radio waves.

Sastry and collaborators using the Gauribidanur array have started mapping bright supernova remnants in the Galaxy at 35 MHz and resolution of 26 arcmin.

Solar terrestrial relationships

Hanumath Sastri has studied the effect of solar wind sector boundary passage on the characteristics of daily variation of H-field at equatorial latitudes, using data corrected for disturbance effects. He finds that there is no systematic and significant response of the daily range of H-field at equatorial latitudes to sector boundary passage, once the disturbance effects are eliminated. This supports the prevailing understanding that the sector boundary effect on equatorial H-field is primarily of disturbance origin.

Sastri has begun a preliminary study of the growth and decay characteristics of blanketing sporadic-E layers using high time resolution (one min interval) ionogram data obtained at Kodaikanal during the winter of 1974–75. He has evidence which shows that strong blanketing layer-type ionization irregularities at E-region altitudes can occasionally decay in a span of about 4 min, at stations in the vicinity of the geomagnetic dip equator. Ionospheric soundings at 1 min intervals are being made at Kodaikanal to obtain a comprehensive picture of the growth and decay characteristics of blanketing sporadic-E layers.

Sastri's investigations of the possible influence of sudden northward transitions of the B_z component of inter-planetary magnetic field on the electric fields in the nocturnal equatorial ionosphere show the absence of any significant and systematic effect on the nocturnal equatorial ionosphere. From a comparative study of the diurnal variation of equatorial geomagnetic field during 'abnormal quiet days'

(AQDs) and 'normal quiet days' (NQDs) Sastri has inferred the presence of an additional field superposed on a NQD field in the equatorial region during AQDs that causes an abnormal shifts of the S_q phase from the usual times. The latitudinal extent of the additional field is seen to control the simultaneity in occurrence of AQDs at stations inside and just outside the equatorial electrojet region. He is now proceeding to evaluate the longitudinal extent of the additional field and to ascertain its possible origin using data from the global network of geomagnetic stations. Using Kodaikanal ionograms Sastri and his coworkers have established that the two basic forms of spread-F and their relative occurrence show a remarkable longitudinal effect in their response to season, sunspot and geomagnetic activity.

The analysis of high time resolution ionograms obtained at Kodaikanal during the light hours 1980 February 11–20 is being carried out with a view to detecting the presence of perturbations in the ionospheric F-region caused by 'atmospheric gravity waves' of eclipse origin predicted earlier on theoretical considerations.

Instrumentation

The decameter wave radio telescope at Gauribidanur has been provided with a multibeam scanning system in the NS array. The scanning system automatically points the beam to give declinations in succession in the range $-30°$ to $+60°$. The fastest rate of scanning is ten times per sec. An eight-channel receiver with high time- and frequency-resolution in the frequency range 25 to 35 Hz has also been added and is being used in conjunction with a high speed galvanometric recorder.

Scanning and display circuits for a charge coupled device imaging system have been built. Several new features *e.g.* registration, storage, digitization and print-out have been added to the prototype analog unit which had been fabricated earlier for fast photometry of lunar occultations .

Jayarajan has designed a spectrograph for obtaining the integrated spectra of extended objects. This has a fast Schmidt as the primary telescope, Bouwer catadioptric system as collimator and a similar system for the spectrograph camera. He has also designed and built the components for a folded Maksutov-type spectrograph camera for use with a fibre-optic image tube.

Saxena has been working on a mathematical procedure of data reduction with a view to minimizing the alignment error in the new optical test for concave aspheric surfaces which he has recently developed. He is also working on a theory in which he uses two crossed compensators to reduce the sensitivity of the method to azimuth.

234-cm Telescope project

Work started on the primary mirror blank early in 1980. The edge and rear face of the mirror have been polished. Treppaning of a cassegrain hole of 72-cm diametre has commenced. The telescope dome is nearing completion. Drive systems for the dome and the shutters are expected to be ready shortly. The 2.8-m aluminizing chamber has been fabricated. The telescope mount fabrication has commenced at M/s Walchandnagar Industries Ltd. Satisfactory progress has been achieved on the design of the drive and the control systems of the telescope. Bhattacharyya and Pati have completed an evaluation of the computer requirements for the telescope control and for off-line numerical work. They have also prepared a preliminary

function block design of the input-output and the interfacing structure for the control and the operation of the telescope and the instruments. Raghu has constructed and tested the prototype circuits enabling simultaneous display of telescope coordinates and star field.

Scientific meetings

Dr M. K. V. Bappu was elected the President of the International Astronomical Union at the XVII meeting of its General Assembly at Montreal. Drs J.C. Bhattacharyya, Ch. V. Sastry and R. Rajamohan also attended. Dr Bhattacharyya participated in IAU Colloquium No. 54 at Princeton on "Scientific research with the space telescope". Dr Ch. V. Sastry attended IAU Symposium No. 86 on "Radio Physics of the Sun" at College Park, Maryland, IAU Symposium No. 91 at Boston on "Solar and Interplanetary Dynamics" and the All India Symposium on "Antennas" held at the Institute of Electronics and Telecommunication Engineering at Bangalore. Drs Bappu and Rajamohan attended IAU Symposium No. 85 on "Star Clusters" held at Victoria, Canada. Dr Kochhar continued with his fellowship at the University of Göttingen and attended the Summer School on 'Physical Cosmology' at Les Houches in June, IAU General Assembly at Montreal and IAU Symposium No. 92 on "Objects of High Redshifts" at the University of California, Los Angeles in August. Dr Krishan attended the autumn school on plasma physics at the International Centre for Theoretical Physics, Trieste, from October 16 to November 23. Drs Bappu, Bhattacharyya, Saxena and Mr S. C. Tapde attended the Silver Jubilee Seminar of the Uttar Pradesh State Observatory, Nainital in November. They also participated in the annual meeting of the Astronomical Society of India at Nainital along with Dr K. R. Sivaraman, Dr Ch. V. Sastry, Messrs K. R. Subramanian, R. Chandramohan, A. Sundereswaran, R. K. Shevgaonkar and C. Viswanath. Dr P. K. Raju attended the Space Science Symposium held at the Banaras Hindu University in January. Mr Jagdev Singh attended the Indo-U.S. Workshop on SMY program held at Udaipur in June. Dr J. C. Bhatacharyya functioned as the National Coordinator for the 1980 total solar eclipse.

Visiting scientists

The following scientists visited the Institute and its field stations and lectured : Dr K. P. Titton, U. K. Schmidt Telescope Unit, Coonabarbran; Dr D. P. Gilra, Kapteyn Astronomical Institute, Groningen; Prof. Z. Kopal, University of Manchester; Dr A. D. Tillu, University of Poona; Dr J. O. Stenflo, Institute of Astronomy, Lund; Prof. E. Muller, Geneva Observatory; Prof. J. Sahade, Institute of Astronomy and Space Physics, Buenos Aires; Dr W. C. Livingston, Kitt Peak National Observatory, Tucson; Prof. R. Pratap, Physical Research Laboratory, Ahmedabad; Dr V. V. Dixit, Indian Institute of Science, Bangalore; Prof. N. C. Mathur, Indian Institute of Technology, Kanpur; Prof. M. R. Kundu, University of Maryland; Dr A. Kubicela, Belgrade Observatory; Prof. B. J. Bok, Steward Observatory, University of Arizona, Tucson; Drs Y. N. Gnedin and G. G. Pavloc, Ioffe Physico-Technical Institute, Leningrad.

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(Asterisk denotes the authors not from the Institute)

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